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FORECAST RESEARCH ON 1968 KODIAK AREA
PINK SALMON FISHERY

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## ERRATA SHEET FOR INFORMATIONAL LEAFLET NO. 114

"Forecast Research on 1968 Kodiak Area Pink Salmon Fishery"

Page 17, paragraph 3, line 8: The word MORTALITY should be changed to SURVIVAL.

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#### INTRODUCTION

This is the third year that numerical forecasts have been presented by the Alaska Department of Fish and Game, Pink Salmon Research Section, for the Kodiak area. Forecasts for the past two years have proven accurate, considering the limited collection of previous data. The 1966 projection called for a total return of 10.9 million pinks; 11.4 million actually returned. The 1967 forecast predicted a failure as the total return was expected to be on the low side of a 2 to 4 million range. The actual return based on Fisheries Research Institute escapement counts and Alaska Department of Fish and Game statistics indicated the total 1967 return was 0.7 million pinks, the smallest return ever recorded for the Kodiak area. However, the true total return is unknown since 75 to 85 percent of the return escaped the fishery in 1967, so that the errors inherent in aerial escapement counts are magnified when comparing this data to other year's when escapements only made up 15 to 20 percent of the total return. In essence then, the true total return was estimated at 1 to 1.5 million pinks. Fortunately, as a failure in the run was expected, the season was sharply curtailed by regulation.

In the past, forecasts have been based partly on escapement to return relationships, with pre-emergent fry density data as a guide. Four years of pre-emergent fry density data are now available from which our 1968 forecast can be projected. In addition, general notes on the yearly climatic conditions which prevailed overwinter 66-67 are included.

1/ This investigation was partially financed by the Commercial Fisheries Research and Development Act (P.L. 88-309) under sub-project 5-4-R-5, Contract No. 14-17-0007-738.

#### CLIMATOLOGY

Information regarding climatic conditions in the Kodiak area has limited value in forecasting salmon runs. However, seasonal changes from year to year can be useful data, especially when there is considerable variation from the normal pattern. The Naval Weather Station on Kodiak keeps accurate records of the daily temperature, rainfall and snowfall, and is the source of the data presented herein (Table 1).

In addition to daily recorded data, periodic flights via light aircraft are made to check snow and ice conditions, stream flows and any unusual conditions which may prevail. Generally, the fall, winter and spring of 1966-67 closely followed the normal pattern and was thought to be quite favorable to egg and fry survival. No periods of prolonged thaw occurred during the winter months, hence the snow and ice pack remained until spring when it melted gradually with the thaw (Figure 1). Precipitation, including snowfall was near normal and no periods of drastic flooding were observed (Figures 2 and 3). In past years, heavy rainfall, warm temperatures and rapid thaws have caused drastic flooding in the Kodiak area; fortunately this phenomena did not occur in the winter or spring of 1966-67.

The effects of climatic conditions on the survival of young pink salmon are not always clear, but it is apparent they can be considerable and to a large degree account for the drastic fluctuations that have been observed in the number of fry surviving to enter the sea.

In summary then, climatic conditions during the 1966-67 spawning, incubation and outmigration periods were considered favorable. That conditions were in fact favorable is supported by the fairly high pre-emergent fry densities that were present in the spring of 1967 although parent escapements were considerably less than those of the past two even-year cycles.

#### PARENT ESCAPEMENT TO RETURN RELATIONSHIP

In this section the Kodiak-Afognak Islands area and the Mainland area are considered separately. Catch, escapement and pre-emergent fry data exists for the Kodiak-Afognak area but only catch and escapement data exists for the Mainland area, and that in many cases is incomplete.

Table 1. -- Temperatures, precipitation and snowfall, 1966-67

Month	Mean Temperature	Precipitation	Snowfall11/
June - 66	46.5°F.	8.59 inches	0.0 inches
July	53.4	3.22	0.0 Hickes
August	52.8	7.50	0.0
September	48.8	6.90	0.0
October	34.3	7.25	4.4
November	34.0	1.81	5.3
December	29.5	5.35	20.7
January - 67	27.4	3.33	17.9
February	28.4	4.16	24.7
March	33.9	1.83	12.9
April	37.7	3.09	T
May	45.8	2.13	0.0
	39.4	55.16	85.9
	1949 through 1	966 Averages	
June	49.8	4.08	0.0
July	5 <b>3.</b> 9	3.52	0.0
August	54.8	4.49	0.0
September	50.3	5.92	T
October	41.0	5.55	2.7
November	35.2	5.58	5.5
December	33.3	4.93	11.8
January	31.1	5.20	15.3
February	30.9	3.69	13.6
March	31.5	4.14	18.6
April	36.6	3.16	7.4
May	42.8	4.27	T
	40.9	54.53	74.9

<sup>1/</sup> One inch of rain equals 10 inches of snowfall, all data from the Naval Weather Station, Kodiak

Fig.1. -- The annual monthly temperatures from June 1966 through May 1967 with a comparison to the 1949-1966 monthly means for the Kodiak area. 55 50 45 oF. 1949-1966 mean Temperature in 1966-67 mean monthly temperatures 40 35 30 25 April Feb. Mar. May Oct. Nov. Dec. Jan. July Sept. June Aug.

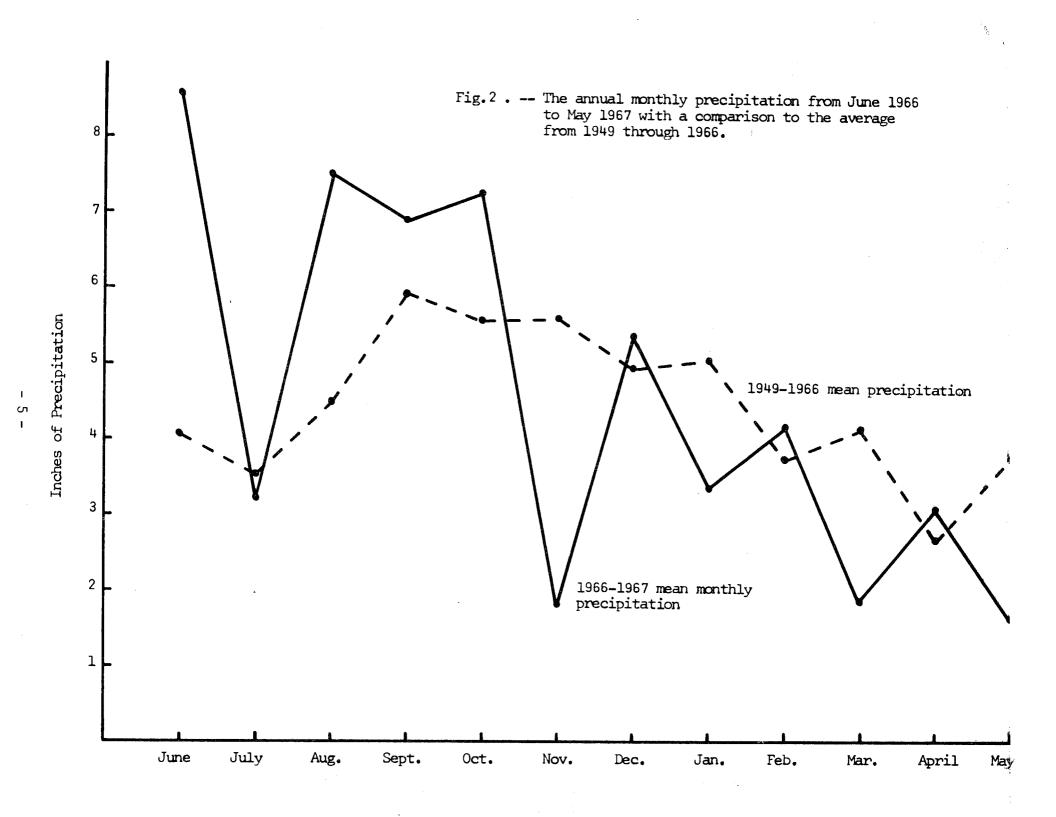
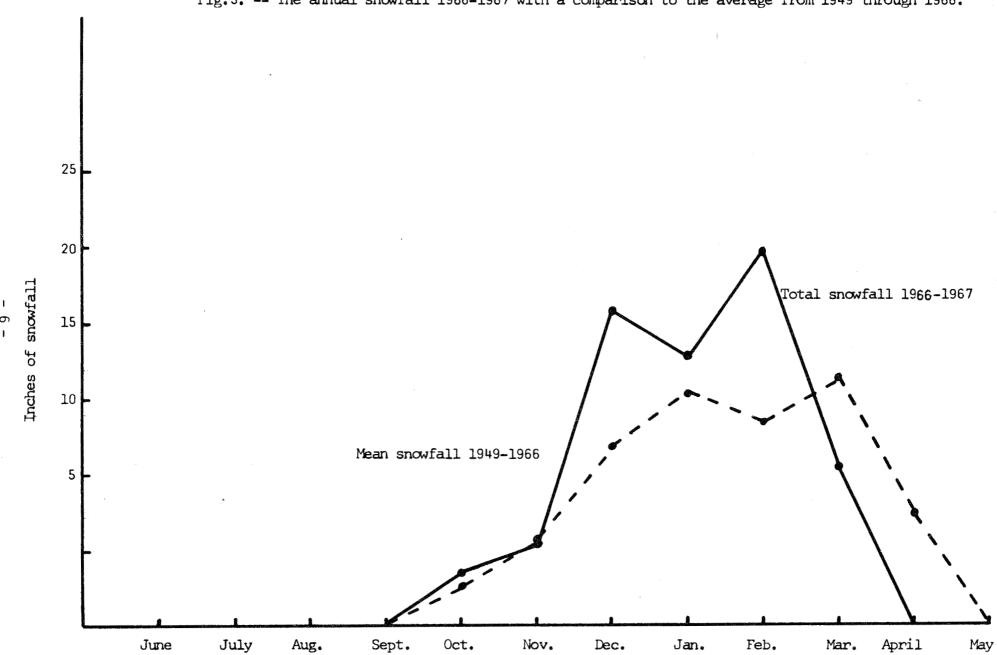


Fig. 3. -- The annual snowfall 1966-1967 with a comparison to the average from 1949 through 1966.



From Figure 4 one can see that the relationship between parent escapements and subsequent returns is rather vague. In general, it is true that as escapements increase returns become greater. However, there are great variations from year to year. A total parent escapement figure does not provide any information regarding the distribution of spawners from one year to another. Secondly, spawning success and overwinter mortalities exhibit tremendous variation from year to year which are to a great extent independent of the spawning escapement, being more dependent upon existing environmental conditions. In essence then, the relationship between parent escapement and subsequent return, when used alone, is quite unreliable and can provide only a general trend; certainly not the accuracy a forecast demands. This is not to say that escapements are unimportant. When used in conjunction with pre-emergent fry data they take on significance as will be shown later in this report.

The average Kodiak-Afognak area escapement for even years from 1952 through 1966 equals some 1.77 million pinks and the average return has equaled some 9.42 million pinks (Table 2). On this basis, the 1.18 million escapement in 1966 would yield some 6.28 million pinks in 1968. It is apparent from Figure 4 however, that a very similar escapement has yielded as many as 16.2 million pinks and as few as 4.9 million. A forecast with this range is nearly useless and misleading. Utilizing pre-emergent fry density data (data obtained after nearly all freshwater mortality has ended), it will be shown that in most cases overwinter mortalities were light during the incubation period of 1966-67, and that the true return will fall in the upper range of the escapement-return relationship.

The pink salmon total run (catch plus escapement) for the Kodiak-Afognak Island area by districts is presented in Table 3. Figure 5 provides the relationship between the total return to the entire Kodiak Island complex and the estimated escapements as determined from peak aerial surveys by the University of Washington, Fisheries Research Institute.

Unfortunately, no pre-emergent fry data exists for the Mainland area. Being so, one has no alternative other than to use the escapement-to-return relationship for that area (Table 4). This is further complicated by the fact that escapement figures are subject to error and aerial surveys of the Mainland area are difficult to obtain. Since 1960, the average even-year escapement approximately equals some 124,000 pinks and the average total return equals some 725,000 pinks. On this basis, the 1968 return is indicated at 643,000. This is only slightly below an average even-year return for the Mainland area. As with the Kodiak-Afognak area, the Mainland area receives the dominant cycle on even years and providing overwinter survival was fav-

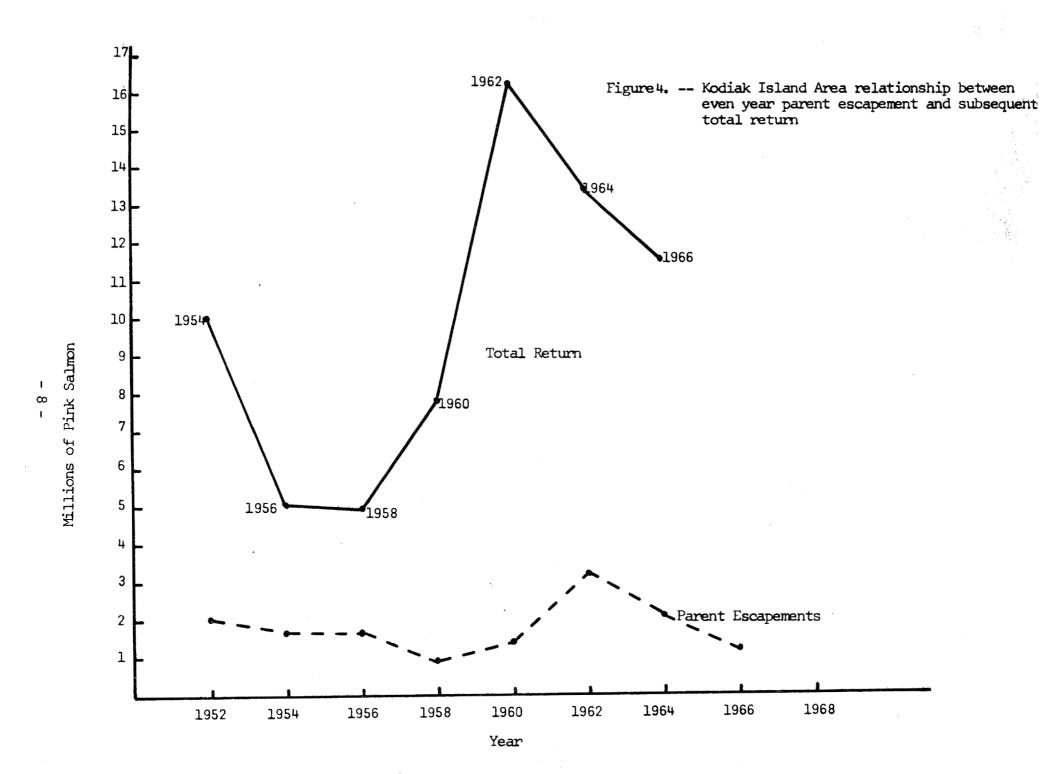


Table 2. -- Kodiak-Afognak Island Area, Pink Salmon Escapementreturn Data, 1952-1966

Year	Catch	Millions of Salmon Escapement 1/	Total Return	Ratio: Total Return to parent Escapement
1952	4.55	2.05	6.60	10.03
1954	8.33	1.70	10.03	5.06
1956	3.35	1.71	5.06	4.94
1958	4,04	0.90	4.94	7.79
1960	6.39	1.40	7.79	16.16
1962	13.00	3.16	16.16	13.32
1964	11.26	2.06	13.32	11.46
1966	10.28	1.18	11.46	
Average	7.65	1.77	9.42	9.82

<sup>1/</sup> All escapement data from F.R.I. aerial surveys conducted since 1952, catch data from ADF&G Management Annual Reports and all data is for the Kodiak and Afognak Areas only where possible to separate Mainland catches.

Table 3. -- Pink Salmon Catch Plus Escapements, By District, 1962-1966 1/

District	Area	1962	1963	1964	.1.965	1966	1967
North Afognak	251	<b>7</b> 92 <b>,</b> 835	113,161	639,166	18,294	1,927,590	4,287
South Afognak	252	1,853,734	557,699	969,459	146,297	1,432,012	58,106
Uganik-Terror	253	1,286,047	696,188	1,994,353	309,892	2,965,697	95,877
Uyak	254	947,412	377,285	893,761	428,775	1,030,266	83,226
Karluk	255	1,505,797	13,979	1,818,076	16,307	686,858	3,707
Red-Sturgeon	256	3,969,712	7,462	2,964,854	2,221	580,736	2,487
Alitak	257	2,366,232	1,741,420	1,582,275	1,386,741	508,900	235,518
Geese ChnSitkalidak	258	2,055,188	1,525,882	1,610,524	921,615	1,287,293	89,142
Ugat-Chiniak	259	1,777,972	1,016,045	942,738	101,412	1,061,159	95,852
Total		16,554,929	6,049,121	13,415,206	3,331,554	11,480,511	668,203

<sup>1/</sup> Catch figures from Kodiak Area Annual Reports; escapement figures from F.R.I. aerial surveys.

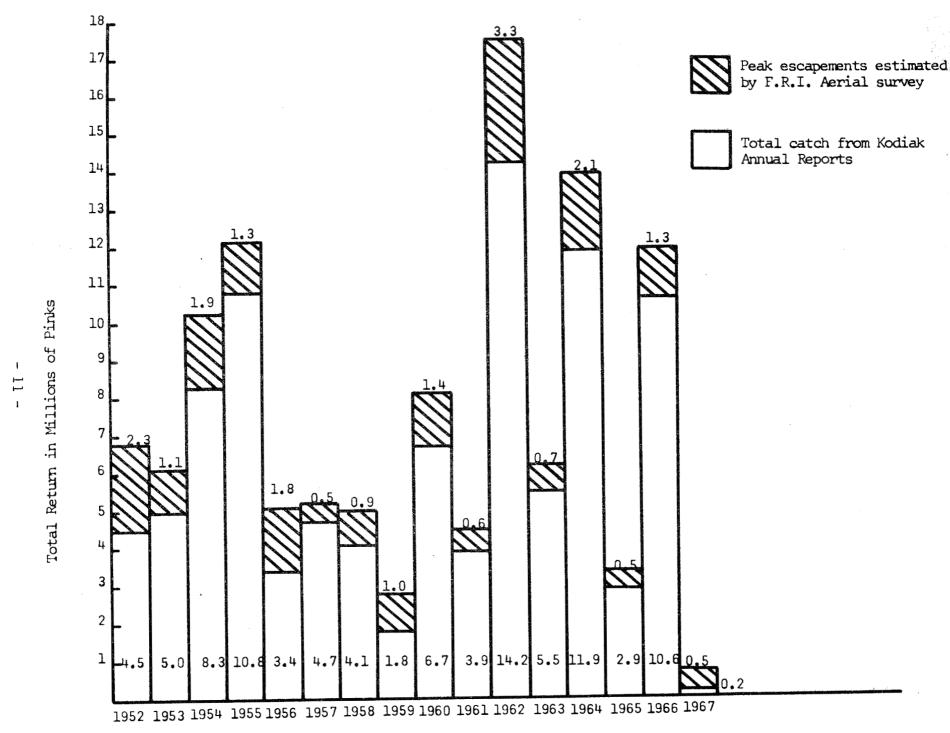


Fig. 5. -- Catch and escapement, Kodiak Island Area, 1952-1967.

Table 4. Mainland area pink salmon escapement-return data, 1960-1966.

Year	Catch	Escapement	Total Return	Ratio: Total Return to parent escapement
1960	295,000	132,000	427,000	1,372,000
1962	1,188,000	184,000	1,372,000	676,000
1964	605,000	71,000	676,000	425,000
1966	315,000	110,000	425,000	
Averages	600,750	124,000	725,000	824,433

orable, as it was for the most part on Kodiak, the return should reach or exceed our expectations. It should be mentioned here that escapement figures are based on peak aerial surveys which do not represent the total escapement.

#### ANALYSIS OF PRE-EMERGENT FRY DENSITY DATA

Pink salmon forecasts in the Kodiak area are based on a variety of factors; i.e. environmental conditions (especially those directly related to climatic conditions) throughout the year, parent escapement to return relationships, pre-emergent fry indices and an intimate knowledge of the fishery and the area involved. All are important, indeed necessary, in order to provide reliable forecasts. Perhaps the pre-emergent fry index is the single most important aspect of this program as it is a measure of freshwater survival rates after the influence of factors affecting survival during the freshwater stage of life history are completed.

Pre-emergent fry indices are a measure of live fry per unit area and not of total production. This is due to the vast differences in the size and extent of the various streams involved and the impossibility of sampling entire spawning areas. Initially this program began in 1962 when some four streams were sampled. Since that time, both the number of streams sampled and the number of samples collected has increased each successive year. In 1967, thirty streams were sampled comprising by far the majority of the spawning populations and in three of the larger streams both an upstream and downstream sample was obtained. Table 5 presents the pre-emergent fry sampling results since the program's inception to the present time.

In estimating the magnitude of the 1968 pink salmon return, the data thus far collected has been treated in various ways. Regression analysis became possible this year as three points exist as a means of estimating the fourth, or the 1968 return. Since usable data exist for only four years and the number of streams sampled and the sample size within the individual streams has increased each successive year, one encounters a myriad of problems. Because of large yearly sample variations, one would need to employ weighting factors in order to make yearly comparisons valid. Due to the quite limited history of data collection and the lack of a sound weighting procedure, a sample of 16 streams in which comparable samples were obtained in each of the four years was utilized for regression analysis (Table 6).

Table 5. -- Pre-emergent fry densities/ .lm<sup>2</sup>, 1962-1967

Stream	1962	1963	1964	1965	1966	1967	
Afognak		23.42		1.08	0.0	6.71***	
Marka						21.11	
Danger		16.90		26.71		40.66	
Perenosa	***	50.68		11.20	13.77	29.39	
Paramanof		5.29		40.83		35.16	
Malina		~-	-			28.89	
Sharatin		11.25	10.40	17.95	1.01	10.49	
Bauman's		7.63	15.30**	48.94	11.92	6.64	
Terror		4.68	7.20**	8.76	0.12	7.50	
Uganik	400	15.06	6.50**	28.77	1.75	2.51	
Little					<b></b> .	36.14	
Brown's	***	15.20		6.98		18.69	
Zachar		12.88		4.42	0.0	0.95	
Uyak			38.80	15.04	5.95	10.39	
Karluk			alate stage			1.45	
Sturgeon			··· =	***		1.34	
Red		27.29	-	10.37*	-	19.53	
Frazer (Dog Salmon) Upstream Downstream		15.49 		2.62		0.54 32.15	
Narrows		37.27			7.73	3.56	
Deadman's					28.35*	13.87	
Humpy - Upstream Downstream				0.0	0.51	0.42 24.24	
Dog Salmon			18.30	AND 1000	7.52		

Table 5. -- Pre-emergent fry densities/ .lm<sup>2</sup>, 1962-1967 (Cont.)

Stream	1962	1963	1964	1965	1966	1967
Seven - Upstream Downstream	13.60	13.77		8.58	5.39 19.60	4.57 28.20
Kaiugnak	60.40	43.15		39.16	6.04	50.42
Kiliuda						11.51
Saltery	5.40	5.30		2.10*	3.50*	0.68
Portage	<sub>pers</sub> mak	od <del>70</del>				10.79
Sid Old's		8.00	0.90**	20.69	0.01	11.99
American	***	12.13	6.80**	17.54	1.48	11.56
Buskin	2.50	36.58	6.80	36.25	7.11	22.35

<sup>\*</sup> Some degree of outmigration probably underway when sample was taken.

<sup>\*\*</sup> Actual field data was lost during the seismic wave, small variance may be involved.

<sup>\*\*\*</sup> Sampling area moved upstream because of loss of area due to land subsidence.

Table 6. -- Index for 16 streams in which samples were taken each of 4 years.

				Sample	Year			
	19	63	19	65	19	66	19	167
Stream	Points sampled	Fry recovered						
Perenosa	50	<b>471</b> 0	50	1041	50	1280	50	2713
Sharatin	35	732	45	1501	55	103	50	1017
Bauman's	50	709	35	3184	30	665	40	494
Terror	<b>7</b> 0	609	70	1139	100	23	75	1045
Uganik	70	1960	70	3743	65	212	70	326
Brown's	20	565	85	1104	0	0	70	2432
Zachar	30	718	50	411	50	0	60	106
Red	150	<b>7</b> 608	180	3449	0	0	140	5081
Dog Salmon	0	0	0	0	110	1537	0	0
Seven	50	1280	<b>7</b> 5	1196	135	2886	100	3046
Frazer	150	4320	125	606	0	0	70	70
Kaiugnak	30	2406	51	3712	50	561	50	4686
American	150	3381	115	3750	90	247	100	2148
Buskin	75	5100	114	7681	120	1586	90	3748
Saltery	70	685	80	312	90	586	90	113
Sid Old's	155	2302	115	4423	80	21	80	1766
Total	1155	37,085	1260	37,252	1025	9707	1135	28,799

1963	Fry - points $37085/1155 = 32.108/2 = 16.054 \times 1.076 = 17.27/ .lm^2$
1965	$37252/1260 = 29.564/2 = 14.782 \times 1.076 - 15.91/ .lm^2$
1966	$9707/1025 = 9.470/2 = 4.735 \times 1.076 = 5.09/ .lm^2$
1967	$28799/1135 = 25.374/2 = 12.687 \times 1.076 = 13.65/.lm^2$

Figure 6 shows a mean estimate of 9.44 million pinks returning to the Kodiak-Afognak Islands complex in 1968. With only three points allowing one degree of freedom that can be used in estimating the fourth, the 90 percent confidence interval is necessarily large; a range of 7.2 to 11.7 million pinks.

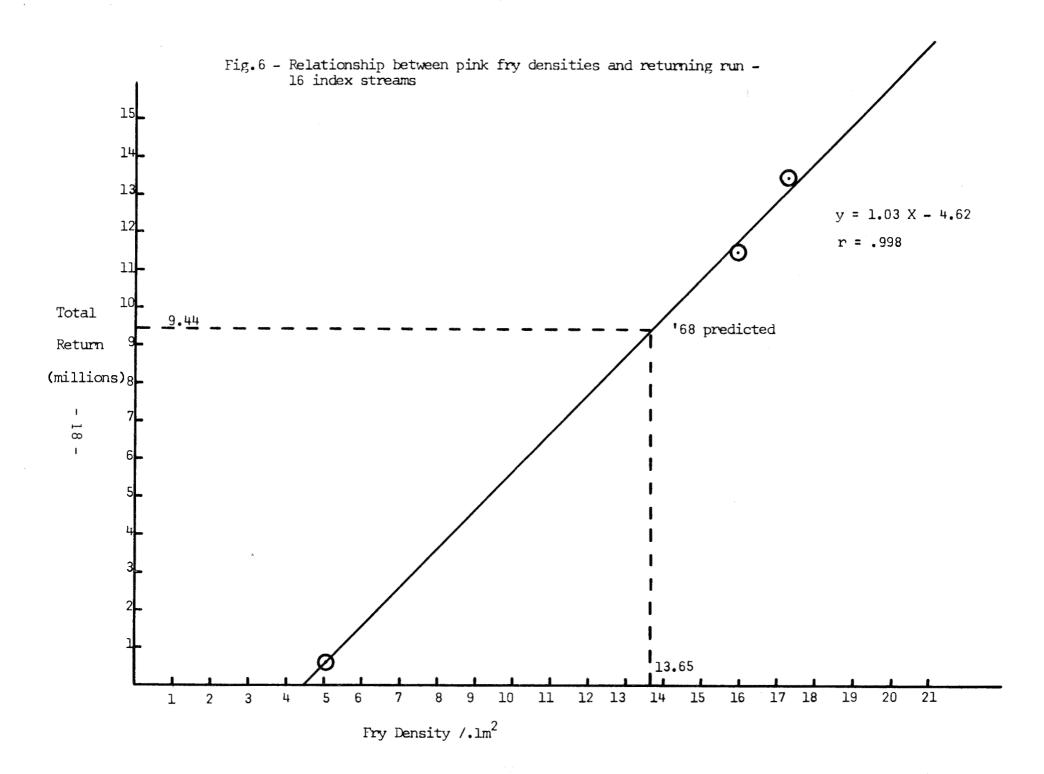
Experimentation with other means of deriving the 1968 forecast gave similar results, or very close to our mean estimate of 9.44 million pinks. One such method involved the use of a ratio between the total return by district in 1966 and the fry density index for 1966 compared to that for the 1968 return. Use of this procedure gave an estimated return of 9.46 million pinks in 1968. Other methods, such as those involving certain weighting procedures, gave equally comparable results. Again, the brief history of data collection precludes the use of these methods here except as supporting information.

In the final analysis it is imperative to note that the studies involved here deal entirely with the freshwater stages of life history which necessitates the assumption that marine mortality rates are relatively constant from year to year. Even comparatively small fluctuations in the average ocean survival rates will have a great influence in the number of fish returning. Ocean mortality as considered here does not include fishing mortality. Through extrapolation; i.e. computing roughly the total fry outmigration, the data indicate ocean mortality has averaged approximately 4.3 percent for each of the past three years with little annual deviation. One would expect, however, that for any single stream or system that the ocean mortality rates would fluctuate much greater than this; but when a large area is considered as a unit the deviation should become less.

#### ESTIMATED PINK SALMON RETURN BY DISTRICT, 1968

A projected return of 9.44 million pink salmon to the Kodiak-Afognak Islands area in 1968 can be made more meaningful to the fishery manager, the fisherman, the processor and associated interests if the estimate is broken down to reveal the areas of expected strength or weakness of the returning run. Although the total picture can be complicated or obscured by fish moving through one district to another, a district breakdown can be accomplished utilizing the pre-emergent fry data in conjunction with parent escapement data.

Weighting the pre-emergent fry index for each stream by the escape-



ment that produced that density results in a weighted fry index related more to total fry production. A breakdown of the pre-emergent data weighted by percent parent escapement appears for each district in Table 7. In Table 8 the 30 streams sampled in the spring of 1967 are listed in order of their weighted index. Figure 7 is a map showing the important pink salmon streams in the Kodiak area. The resultant weighted index does not necessarily imply that a particular stream will or will not have a large or small return in relation to the total return. It is only in relation to the productive potential of the particular stream that it will be meaningful.

The percentage of return by district, based on the mean estimate of 9.44 million pinks in 1968 is listed in Table 7. The largest portion of the return is expected in the Red River district (24.1%) which has by far the highest weighted index. On the other hand, Sturgeon River closely adjacent exhibited a very low pre-emergent fry index resulting in a low weighted index, hence cannot be expected to produce well in 1968. By far the bulk of the projected 2.3 million pinks expected to return to the Red River-Sturgeon River district will be returning to Red River.

In addition, sampling in Karluk River adjacent to the Red-Sturgeon district indicated very weak pre-emergent fry densities and as the 1966 escapement into the Karluk River was moderate at best, the resulting weighted index was low. Only 0.2 million pinks are expected to return to the Karluk district in 1968 which will be one of the lowest returns to that district for any recorded even year.

Therefore, two potentially important streams (Karluk and Sturgeon) are expected to receive failing or near failing returns in 1968, both closely adjacent to Red River which is expected to receive an excellent return. Tagging experiments and analysis of the fishery show that fish destined to all three streams intermingle in both districts. This then indicates that any fishery in the Karluk and/or Sturgeon River sections may endanger spawning escapements into these systems but would probably not be detrimental to Red River.

The Uyak Bay district is expected to receive six percent of the total 1968 return or approximately 566,000 pinks. This is one-half the parent return (1966). Pre-emergent fry densities were light as is the resultant weighted index, well below the average for an even-year return. Zachar River was especially weak in this area.

The Uganik-Terror Bay district should receive approximately 1.4 million pinks in 1968 which is much below the parent return. Both Terror and Uganik

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Table 7. -- Pre-emergent fry density data, weighted indices, and expected return by district

			•	-	, .		•		
Stream and Area	No. of Points	Fry Recovered	Fry Density	Escapement (FRI)	Percent Escapement	Weighted Index	District Index	Percent Return to District	Expected No. of Fish
259									
Buskin American Sid Old's Cr. Saltery Portage 258	90 100 80 90 60	3738 2148 1766 113 1202	22.35 11.56 11.99 0.68 10.79	20,000 24,000 35,000 17,000 22,000	1.73 2.07 3.02 1.47 1.90	38.66 23.93 36.21 1.00 20.50	120.30	9.50	897,000
Kiliuda Kaiugnak Seven-Upstream Seven-Downstream	60 50 50 50	1283 4686 425 2621	11.51 50.42 4.57 28.20	9,000 10,000 6,000 10,000	0.77 0.86 0.52 0.86	8.86 43.36 2.38 24.25	78 <b>.</b> 85	6,22	587,000
257							70.03		307,000
Humpy-Upstream Humpy-Downstream Deadman Narrows Cr. Frazer-Upstream Frazer-Downstream	60 60 80 50 70	47 2703 2063 331 70 3585	0.42 24.24 13.87 3.56 0.54 32.15	3,000 33,000 12,000 600 2,000 19,000	0.26 2.85 1.03 0.05 0.17 1.64	0.11 69.08 14.29 0.18 0.09 52.73	136.48	10.78	1,018,000
256	. *						130.40	10.70	1,010,000
Red Sturgeon	140 110	5081 273	19.53 1.34	175,000 90,000	15.11 7.77	295.10 10.41	305.51	24.12	2,277,000
255 Karluk	120	323	1.45	225,000	19.43	28.17	28.17	2,22	209,000

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	Uyak Browns Lagoon Zachar	80 <b>7</b> 0 60	1545 2432 106	10.39 18.69 0.95	40,000 24,000 16,000	3.46 2.07 1.38	35.95 38.69 1.31	<b>75.</b> 95	6.00	566 <b>,</b> 000	
	253							73.33	0.00	200,000	
	Little Uganik Terror Baumans Cr.	100 70 75 40	6718 326 1045 494	36.14 2.51 7.50 6.64	37,000 80,000 85,000 9,000	3.19 6.91 7.34 0.78	115.29 17.34 55.05 5.18	192.86	15.23	1,438,000	
	252										
- 21: -	Elbow Cr. Afognak Marka Danger	50 85 95 65	1017 1060 3727 4913	10.94 6.71 21.11 40.66	13,000 26,000 35,000 25,000	1.12 2.24 3.02 2.15	12.25 15.03 63.75 87.42	178.45	14.09	1,330,000	
	251							1/0.45	14.03	1,330,000	
	Perenosa Cr. Paramanof Malina	50 65 90	2731 4284 4832	29.39 35.16 28.89	20,000 17,000 19,000	1.73 1.47 1.64	50.84 51.69 47.38	149.91	11.84	1,118,000	
	Total	2375	67,652		1,158,000	100.00	1266.48	•	100.00	9,440,000	
	Average	23.3	. <b>,</b>	15.33		200.00	22004.0			- <b>, ,</b>	

Table 8. -- Streams in order of weighted index

Stream	1966 Parent Escapement	Percent of Total Escapement	Fry Index Pinks /.lm <sup>2</sup>	Index Weighted for Parent Escape
Frazer (Dog Salmon)				
Upstream	2,000	0.17	0.54	0.09
Humpy -Upstream	3,000	0.26	0.42	0.11
Narrows	600	0.05	3.56	0.18
Saltery	17,000	1.47	0.68	1.00
Zachar	16,000	1.38	0.95	1,31
Seven - Upstream	6,000	0.52	4.57	2.38
Bauman's	9,000	0.78	6.64	5.18
Kiliuda	9,000	0.77	11.51	8.86
Sturgeon	90,000	7.77	1.34	10.41
Sharatin	13,000	1.12	10.94	12.25
Deadman's	12,000	1.03	13.87	14.29
Afognak	26,000	2.24	6.71	15.03
Uganik	80,000	6.91	2.51	17.34
Portage (Ugak)	22,000	1.90	10.79	20.50
American	24,000	2.07	11.56	23.93
Seven -Downstream	10,000	0.86	28.20	24.25
Karluk	225,000	19.43	1.45	28.17
Uyak	40,000	3.46	10.39	35.95
Sid Old's	35,000	3.02	11.99	36.27
Buskin	20,000	1.73	22.35	38.66
Brown's	24,000	2.07	18.69	38.69
Kaiugnak	10,000	0.86	50.42	43.36
Malina	19,000	1.64	28.89	47.38
Perenosa	20,000	1.73	29.39	50.84
Paramanof	17,000	1.47	35.16	51.59
Frazer -Downstream	19,000	1.64	32.15	52.73
Terror	85 <b>,</b> 000	7.34	7.50	55.05
Marka	35,000	3.02	21.11	63.75
Humpy -Downstream	33,000	2.85	24.24	69.08
Danger	25,000	2.15	40.66	87.42
Little	37,000	3.19	36.14	115.29
Red	175,000	15.11	19.53	295.10
	1,158,600	100.00		

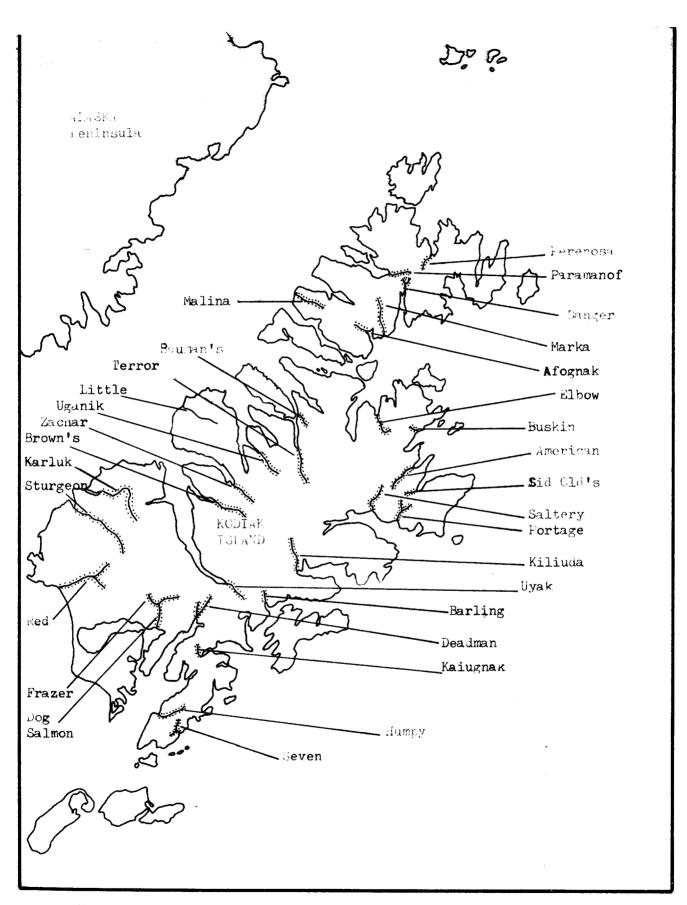


Figure 7. Map of the Modiak Area showing the important pink salmon streams.

Rivers received excellent parent escapements. However, pre-emergent fry sampling clearly indicated overwinter survival was extremely poor. For reasons not clear, excessive mortalities occurred in both of these systems shortly following spawning as large numbers of dead eggs were excavated, having died before reaching the "eyed" stage which normally occurs by late October or early November. In direct contrast, Little River enjoyed a very high rate of overwinter survival, had an excellent parent escapement and exhibited an excellent weighted index; all of which tends to point out that the strength of this district will rely chiefly on the return to Little River. Terror River cannot be expected to produce more than a fair, perhaps poor return, and Uganik River may well prove a failure.

The two districts surrounding Afognak Island should receive 26 percent of the total 1968 return which represents some 2.45 million pinks. Obviously, this is a much better than normal return for an even-year cycle. With the exception of Afognak River, all streams on Afognak Island had very good parent escapements and exhibited high overwinter survival. Pre-emergent fry densities were excellent throughout and there can be no doubt that the Afognak area will be a prime producer in 1968.

The Ugak-Chiniak district is expected to contribute approximately 9.5 percent of the 1968 pink salmon return, or about 900,000 pinks. This is slightly below an average even-year return for this district. A major weakness is expected in the Saltery Cove area due to low parent escapements into Saltery River which resulted in a very low pre-emergent fry index.

On the east side of Kodiak, the Geese Channel-Sitkalidak district (Dangerous Cape to Cape Trinity) is expected to produce about 6.22 percent of the 1968 return or some 587,000 pink salmon. The Kiliuda Bay area may be weak, but the Kaiugnak Bay area should be excellent. Seven Rivers is in question as upstream pre-emergent fry densities were quite light, however, downstream they were fairly strong. The significance of these facts is difficult to determine with any degree of authority as the spring of 1967 was the initial year of downstream sampling. The best estimate, in view of the above information, is that Seven Rivers will receive a poor, or at best, fair return in 1968.

The Alitak district is expected to produce 1.0 million pinks in 1968, which if true, will be an average even-year return to this area. Again the complete picture is obscured by comparately large differences between upstream and downstream pre-emergent fry densities in Frazer (Dog Salmon) and Humpy Rivers. It is apparent that Humpy River is beginning to recover from

two years of natural disaster but complete recovery will depend largely upon sufficient escapements in 1968 which may or may not allow a fishery in that area in 1968.

It is well to point out here that district forecasts are highly subject to variations since many fish destined for one district are caught on the capes or in some other district. Tides, weather conditions, shifting of the commercial effort, regulatory policies, and so forth all affect the outcome of district forecast. In general, however, the trends are clear.

#### SUMMARY

- Environmental conditions influencing survival of young pink salmon over winter 1966-67 were considered favorable. Near normal rainfall, snowfall and temperatures prevailed throughout the year. No periods of extreme conditions were noted.
- 2. Based on an escapement to return relationship, the projected return to the Mainland district is 643,000 pink salmon in 1968, a near average even-year return.
- 3. The escapement to return relationship for the Kodiak-Afognak complex is quite vague. This relationship shows that the 1966 escapement of 1.18 million pinks would yield some 6.26 million pinks in 1968. However, similar escapements have produced as few as 4.9 and as many as 16.2 million pinks. Pre-emergent fry sampling indicates the return will be considerably better than 6.26 million pinks.
- 4. Analysis of the 1968 pre-emergent fry density data indicates a mean estimate of 9.44 million pinks returning to the Kodiak and Afognak areas. The 90 percent confidence interval is quite large, (7.2 to 11.7 million pinks) due to the limited history of data collection. Regression analysis was based on a stream sample size of 16 streams in which samples have been taken in each of four years.
- 5. Weighting the pre-emergent fry index for each of the nine Kodiak districts by a percentage of the total parent escapement resulted in a district break-down of the total projected return of 9.44 million pinks. In general, the two Afognak districts are expected to produce 26 percent of the total 1968 pink salmon return; 24.1 percent in the Red River district with Sturgeon River returns very weak; 15.2 percent in the Uganik-Terror district

with Little River producing the bulk of the return in this area; 10.8 percent in the Alitak district with Humpy River expected to show considerable improvement over the past two years; 9.5 percent in the Ugak-Chiniak district with Saltery River expected to receive a very poor return; 6.2 percent in the Geese Channel-Sitkalidak district with the bulk of the fish returning in the Kaiugnak Bay area; and finally 2.2 percent in the Karluk district which constitutes a failure for that district. District estimates are subject to variation but do present a general trend.

6. The overall evaluation of the 1968 pink salmon return can be termed as fair but below the last three even-year returns and somewhat spotty in nature. The best estimate is for 9.44 million pinks returning to the Kodiak-Afognak area and an additional 640,000 to the Mainland area.

#### REFERENCES

#### BEVAN, DONALD E.

- 1966. Stream Surveys in the Kodiak Island Area, 1966. University of Washington, Fisheries Research Institute, Seattle, Washington.
- 1961. Variability in Aerial Counts of Spawning Salmon. Journal of the Fisheries Research Board of Canada. Vol. 18, No. 3. pp. 337-348.

#### HENNICK, DANIEL P.

- 1967. Forecast Research on 1967 Kodiak Area Pink Salmon Fisheries. Alaska Department of Fish and Game, Informational Leaflet No. 100, Juneau, Alaska. 22 p.
- 1966. Forecast Research on 1966 Kodiak Area Pink Salmon Fisheries.
  Alaska Department of Fish and Game, Informational Leaflet
  No. 79, Juneau, Alaska. 24 p.

#### NOERENBERG, WALLACE H.

- 1965. Forecast Research on 1965 Central Alaska Pink Salmon Fisheries: Kodiak Area, Alaska Department of Fish and Game, Informational Leaflet No. 65, Juneau, Alaska. 54 p.
- 1963. Salmon Forecast Studies on 1963 Runs in Prince William Sound. Alaska Department of Fish and Game, Informational Leaflet No. 21, Cordova, Alaska. 17 p.
- 1961. Observations on Spawning and Subsequent Survival of Fry of the 1960 Salmon Runs in Prince William Sound, Alaska. Alaska Department of Fish and Game, Memorandum No. 5. Cordova, Alaska. 22 p.

#### ROYS, ROBERT S.

1964. Forecast Research on 1964 Alaska Pink Salmon Fisheries: Kodiak Area. Alaska Department of Fish and Game, Informational Leaflet No. 36, Juneau, Alaska. 52 p. SIMON, ROBERT J., DEXTER F. LALL, PAUL C. PEDERSEN AND MELVAN E. MORRIS, JR.

1967. Kodiak Area Annual Report, 1966. Alaska Department of Fish and Game. Mimeographed. Kodiak, Alaska. 106 p.

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